Yarn Measuring Device, in Particular for Nonstationary Applications

[0001] The invention relates to a yarn measuring device which is intended in particular as a hand-operated measuring instrument.

[0002] Machines that use yarn often draw many individual yarns from so-called creels, and the yarns then travel to the machine. In practice, there is sometimes a need to be able to determine the yarn quantity and/or yarn speed of the yarns travelling to the machine. For that purpose, a yarn measuring device is known for instance from German Published, Non-examined Patent Application DE-OS 2557593, which is constructed as a hand-operated measuring instrument and is suitable for freehand measurements. This yarn measuring device has a pistol-shaped two-legged housing, one leg of which is embodied as a handle and the other leg of which has a yarn catcher on its free end. The yarn catcher is formed by a pivotably supported lever, which has a peg with a thickened head on its free end as a yarn guide element. A drum that is connected to a rotary speed measuring device is rotatably supported concentrically with the axis of rotation of the pivot lever. The pivot lever is connected, via a rack drive mechanism, to an actuating lever that is accessible on the front of the housing part that forms the handle. It can be moved there onto the handle, counter to the force of a prestressing spring, causing the pivot lever to execute a pivoting motion of approximately 180°. If a yarn was previously engaged from behind with its yarn guide element, then the yarn is as a result placed on the rotatably supported drum, which is thus set into rotation by the yarn motion. The rotary speed of the drum is a measure for the yarn speed.

[0003] Measuring the yarn speed is adequate for some applications. However, a more-versatile use of the yarn measuring device is a goal. It is precisely this which the present invention makes possible:

[0004] The yarn measuring device of the invention is suited in particular for freehand measurements. It has a housing with a handle and an actuating device provided on the handle. The yarn measuring device also has a yarn catcher, which is supported movably adjustable between a tuck position and a measuring position. It can be moved back and forth between its tuck position and its measuring position via an actuating mechanism and by means of the actuating device. A yarn guide element is also provided, by way of which the yarn catcher, when it is in the measuring position, guides the yarn. Between the yarn guide element and the yarn catcher, that is in the measuring position, a yarn tension meter is provided, which serves to detect the yarn

tension and furnishes an electrical signal accordingly. This creates one basic prerequisite for more-versatile use of the yarn measuring device. Not only can the yarn speed or yarn quantity be measured, but also the yarn tension, which broadens the range of application of the hand-operated measuring instrument substantially. With the arrangement of the invention, a prerequisite is moreover created for measuring the yarn tension virtually entirely independently of the skill of the user. The angle at which the yarn measuring device is held relative to the yarn does not matter, nor is any manual skill necessary. The yarn travels to both sides of the yarn tension meter via one yarn guide element on each side, so that the angle at which the yarn brushes over the yarn tension meter is correctly defined without any action on the part of the user. Incorrect measurements can thus be avoided. The yarn is also hardly capable of jumping off the yarn measuring device during measurement, even if the yarn measuring device is not being held with its handle entirely parallel to the yarn.

[0005] The yarn guide element carried by the yarn catcher is preferably a yarn spool that is rotatably supported with little friction and is set into rotation by the yarn. This makes accurate yarn tension measurements possible without incorrectly reading the yarn tension of the moving yarn.

[0006] The measuring position of the yarn catcher is preferably defined by a stop means, so that the position is maintained precisely, regardless of the user's skill or any tolerances in the actuating mechanism. The stop means is for instance a stop face, peg, protrusion, or the like, that defines the path of motion of the yarn catcher.

[0007] The yarn catcher is preferably a pivotably supported lever. Alternatively, however, displaceable, linearly movable elements or the like can be used. However, embodying the yarn catcher as a pivot lever has the advantage that a yarn can be taken up and shifted to the measuring position especially easily.

[0008] The yarn guide element can be connected not only with the yarn tension meter but also with a sensor device, such as a rotary position sensor or an rpm sensor. As a result, the yarn speed, yarn quantity, and the like can all be measured.

[0009] The yarn tension meter preferably has a yarn applicator element, embodied as a pin, for instance a ceramic pin, which extends substantially parallel to the axis of rotation of the lever and transversely to the yarn travelling through. The pin can be supported directly by a force sensor. No perceptible motion of the pin occurs under the influence of the force originating at the deflected yarn, and as a result the yarn tension meter responds quickly and precisely.

[0010] The yarn tension meter is preferably connected to a processing device, disposed in the hand-operated measuring instrument inside the housing; the processing device is connected to a display device. The display device, together with a control knob, serves to control the yarn measuring device. The control knob is preferably set up for one-handed operation. This is achieved by embodying it as a knob/pushbutton. The setup of various measurement specifications can be done by way of a menu guide specified by the processing device. The selection of menu items can be made by rotating the control knob, and the selection of menu items can be done by depressing the control knob.

[0011] The processing device makes an enhanced functionality possible. For instance, yarn tension can be measured in various units, such as average yarn tension, peak yarn tension, and so forth. The deviation from a normal tension can also be displayed. It is furthermore possible to display the yarn length in various units, such as meters, inches, and yards. It is furthermore possible to display the yarn speed in different units both as an average value and a peak value and to display fluctuations in the yarn speed.

[0012] In an advantageous embodiment, the processing device is furthermore connected to an interface which can receive signals from an external source. The interface can be embodied as a plug connector device for cables, or it can be cordless. For instance, signals can arrive here that characterize the rotary speed of the machine. The processing device can thus determine weighted variables, such as yarn length per machine revolution, and display them.

[0013] For the power supply to the processing device, the hand-operated measuring instrument has one or more batteries or accumulators. These are preferably embodied in the housing, in a battery compartment whose closure lid at the same time forms the actuating device. The actuating mechanism can serve as a locking device, which unlocks the closure lid as soon as the lid, for transferring the yarn catcher from its tuck position into the measuring position, is pressed onto the housing or into it. Unlocking of the closure lid is no problem then, because it is held by the user's hand. However, as soon as it is released, it snaps back into its initial position, in which once again it is locked by the actuating mechanism. If it needs to be removed, this can be done by holding the yarn catcher in its measuring position while the actuating device is released.

[0014] Further details of advantageous embodiments of the invention will become apparent from the drawing, the description, and the dependent claims. One exemplary embodiment of the invention is shown in the drawing. Shown are:

[0015] Fig. 1, a yarn measuring device, in a side view;

[0016] Fig. 2, the yarn measuring device of Fig. 1 on a different scale, in plan view;

[0017] Fig. 3, the yarn measuring device of Fig. 2 on a different scale, in a fragmentary and partly cutaway view;

[0018] Fig. 4, the yarn catcher of the yarn measuring device in the tuck position;

[0019] Fig. 5, the yarn catcher of the yarn measuring device in the measuring position;

[0020] Fig. 6, the yarn measuring device in a schematic longitudinal section showing the actuating device in the unactuated state;

[0021] Fig. 7, the yarn measuring device of Fig. 6 showing the actuating device in the actuation position;

[0022] Fig. 8, the yarn measuring device of Figs. 6 and 7 with the battery compartment closure lid removed; and

[0023] Figs. 9-11, various displays appearing on the yarn measuring device.

[0024] In Fig. 1, a yarn measuring device 1 is shown which has an elongated housing 2, bent at an obtuse angle, with two housing portions 3, 4. The longer housing portion 4 serves as a handle. On its back side, which faces the user during use, there are a display 5 and a control knob 10. On its front side, which points away from the user, there is a displaceably or pivotably supported trip lever 6. This lever can be embodied in shell form as a housing portion or housing part and, as will become clearer hereinafter, can at the same time serve as a battery compartment lid.

[0025] On its front free end 7, the yarn measuring device 1 has a yarn catcher 8, which includes a pivotably supported lever 9. The lever 9, which can be seen in plan view in Fig. 2, is disposed between two forklike legs 12, 14 of the housing portion 3, which define a passage 11. On its free end 15, the lever 9 has a yarn guide element 16, in the form of a rotatably supported yarn spool 17 whose axis of rotation 18 is oriented parallel to the pivot axis 19 of the lever 9 (Fig. 3). The yarn catcher 8 formed by the lever 9 is pivotable between two positions I, II, which are shown in Figs. 4 and 5. The pivoting angle α is preferably somewhat less than 180°. Position I is a tuck position, in which an imaginary connecting line between the axis of rotation 18 and the pivot axis

19 is at approximately right angles to a yarn 21 that is to be sensed. The other position II (Fig. 5) is the measuring position, in which the lever 9 rests on a stop peg 22.

[0026] A yarn guide element 23 in the form of a rotatably supported yarn spool 24 is disposed concentrically to the pivot axis 18, or in the immediate vicinity thereof, and like the yarn spool 17, it has a yarn groove. The yarn grooves of the yarn spools 17, 24, as Fig. 3 shows, are disposed in a common plane E, to which the pivot axis 19 and the axis of rotation 18 are perpendicular. The yarn spool 24 is connected for instance to a rotation transducer 25. The rotation transducer outputs electrical signals in accordance with the rotation of the yarn spool 27. The rotation transducer 25 is connected to a processing device, not further shown here, which is accommodated in the form of a microcomputer, for instance on the printed circuit board 26 that can be seen in Figs. 6 and 7. The processing device 26 is connected with the display 5, which is used for equipment setup, operation, and display of measured values.

[0027] As Fig. 5 shows, between the yarn guide element 23 and the yarn guide element 16 that is in the measuring position, there is a yarn applicator element 27, in the form of a pin 28 that extends approximately parallel to the pivot axis 19 (Fig. 3). With its free end, the pin 28 protrudes into the passage 11, and on its other end it is connected to a force sensor 29. The force sensor 29 and the pin 28 form a yarn tension meter 31. This yarn tension meter is connected to the processing device and sends electrical signals to it that correspond to the yarn tension detected. As Fig. 5 shows, the pin 28 is disposed above a tangent that connects the yarn spool 24 with the yarn spool 17, so that the yarn 21 travelling through travels over the pin 28 at an obtuse angle. The precise size of this angle is defined by the position of the stop peg 22.

[0028] The lever 9 is provided with a funnel-shaped cutout 32, which when the lever 9 is pivoted into the measuring position is located above the pin 28 without touching it.

[0029] The pivoting of the lever 9 is effected by actuation of the trip lever 6, which in this sense forms an actuating device. Figs. 6 and 7 show one exemplary embodiment of the associated actuating mechanism 33, which connects the trip lever 6 to the lever 9. The actuating mechanism 33 includes a gear wheel 34, which is connected to the lever 9 in a manner fixed against relative rotation and meshes with a rack 35 that is supported axially displaceably in the housing 2. With its other end the rack 35 meshes with a gear wheel 36 that is rotatably supported in the housing 2. The gear wheel 36 meshes with a gear wheel 37, which is rotatably supported but connected in a manner fixed against relative rotation to a lever 38. This lever has a hook-shaped

end 39 which, in the position of repose, engages an opening 42 of the trip lever 6 with a luglike extension 41. The trip lever is constructed in shell form; on one end, it has a peg protruding laterally away from it, or some similar protrusion, for pivotable support in a sliding-block guide 43. The opening 42 is oriented approximately radially to the pivot axis thus defined by the sliding-block guide 43, which axis is approximately perpendicular to the plane of the drawing in Fig. 6. The lever 38 is disposed such that the protrusion 41 moves out of the opening 42 when the lever 6 is pressed onto the housing 2 and into it. In that process, a front wall 44 presses against the lever 38, even if the protrusion 41 has moved out of the opening 42. In the position of repose, the trip lever 6 preferably forms an obtuse or acute angle with the lever 38.

[0030] At some suitable point, the actuating mechanism 33 has a spring means. For instance, this spring means can be embodied by a tension spring 45, which prestresses the rack 35 in a selected longitudinal direction in such a way that the lever 9 is prestressed toward its tuck position I.

[0031] The trip lever 6 is embodied as a battery compartment lid. It spans a battery compartment 46 located beneath it, in which one or more batteries 47, 48 are disposed for supplying power to the processing device. The batteries can be supported by the printed circuit board 26. The printed circuit board for instance has an additional switch that activates the processing device. The actuating mechanism 33 preferably has a certain amount of play or elasticity, which makes further depression of the trip lever 6 possible for activating the switch 49, once the lever 9 has reached its measuring position II.

[0032] The yarn measuring device 1 described thus far functions as follows:

[0033] The yarn measuring device 1 is switched on when pressure is exerted on the control knob 10. Alternatively or in addition, it can be provided that the yarn measuring device 1 be switched on by actuation of the trip lever 6. The yarn measuring device is automatically switched off once a waiting period has elapsed without further actuation, or alternatively by holding the control knob down longer. The display 5 is shown in Fig. 9 at the top left with all the display options. By twisting and/or pressing on the control knob 10 (depending on the embodiment), the three fundamental operating modes of measurement (MEASURE), storage and memory (MEM) and setup (SETUP) can be selected. The menu used for the measurement is shown in Fig. 9 in the left-hand column, line 2. If it is activated, the measurement of the rotary machine speed, yarn length, yarn tension, and yarn speed can be selected. Line 2 in Fig. 9 illustrates various displays, for instance for average rpm or current rpm (third and fourth

columns). The first line, conversely, shows various setups (SETUP), for instance for the unit selected (m/min, m, yd/min, or inch).

[0034] Similarly, the measurement of the yarn length can be selected in various operating modes (Fig. 9, third line, second column, through fifth line, first column). The menus and displays on the display 5 for the yarn tension can be seen in Fig. 9, fifth line, second column, through Fig. 10, third line, second column. The other displays pertain to the yarn speed.

[0035] Once the desired measurement mode has been selected, the yarn measuring device is brought to the yarn, as Fig. 4 shows, until the yarn spool 17 engages the yarn 21 from behind. If the trip lever 6 is now actuated, the lever 9 pivots out of its tuck position I into its measuring position II, as Fig. 5 shows. In the process, the lever 9 presses against the stop peg 22 and thus assumes a defined position. In that position, the yarn 21 travels over the pin 28, and a force corresponding to the yarn tension is recorded at the force sensor 29. This force is converted by the processing device into a yarn tension value and shown on the display 5; see Fig. 9 or 10. Depending on the selection chosen, the average tension, peak tension, rated tension, deviation from the rated tension, or the like can be displayed.

[0036] The actual measurement is then activated when the control lever 6 is pressed firmly into the housing 2, once the lever 9 has already reached its measuring position II. The control lever 6 then actuates the switch 49 for performing the measurement. In its previous position, in which the lever 9 has already reached the stop peg 22 but the switch 49 is not yet actuated, the control lever 6 can be stopped if needed by means of a slide, not otherwise shown.

[0037] The printed circuit board 26, or the processing device disposed on it, can be provided, as Figs. 6 and 7 show, with an interface 51 in the form of a plug socket, provided on the lower end of the housing 2, or in the form of a wireless radio path. The interface 51 serves to carry signals (data) in and out. Such signals or data can represent the machine speed of a knitting machine connected to it or similar external data that are taken into account by the processing device. This makes it possible for instance to display the machine speed, as shown in Fig. 9, column 2, line 2 through column 1, line 3. Also, because external data are made available, it becomes possible to calculate and display pertinent variables, such as the yarn length per machine revolution (Fig. 9, column 2, line 3). Also via the interface 51, data can be sent onward as needed to some external device. This can be of value particularly whenever many yarns in succession must be scanned and monitored with the yarn measuring device 1.

[0038] Changing the batteries 47, 48 is done as follows:

[0039] If the battery compartment 46 is to be opened, the trip lever 6 is pressed into the housing 2. In the process, the protrusion 41 moves out of the opening 42, so that there is no longer any locking or other positive engagement between the trip lever 6 and the lever 38. The trip lever 6 that forms the battery compartment lid cannot fall off, however, because it is firmly held by the fingers of the user, who must hold the trip lever 6 against the force of the tension spring 45. For removing the battery compartment lid, the lever 9 is now held for instance by hand in its measuring position, while the trip lever 6 is released. Because the lever 38 stays in its deflected position visible in Fig. 7, the lid can now be freely removed. This can be seen from Fig. 8.

[0040] The battery compartment lid is installed in reverse order. The lever 9 is shifted to the measuring position II, after which the trip lever 6 can be inserted into the opening in the battery compartment. If the lever 9 is released, the lever 38 catches on the trip lever 6 and in turn keeps the trip lever in place.

[0041] The yarn measuring device 1 of the invention is a hand- operated measuring instrument, with a yarn catcher 8 which, when a trip lever 6 is tripped, places the yarn over a yarn applicator element 27 of a force sensor 29. The yarn tension detected, like the yarn speed detected, is delivered to a processing device for display and further processing. The device makes one-handed operation possible. The boomerang- shaped housing 2 is embodied on one end as a handle, on which a trip lever, a control knob 10 embodied as a knob/pushbutton, and a display 5 are all disposed. The control knob 10 can be twisted and depressed by the user's thumb, so that full operation, that is, the selection of all the measurement and operating modes, can be done with only the thumb. The measurement is performed by means of the trip lever 6, which actuates both the yarn catcher 8 and a measurement activation switch 49.

List of Reference Numerals:

1 Yarn measuring device
2 Housing
3, 4 Housing portions
5 Display
6 Trip lever
7 End
8 Yarn catcher
9 Lever
10 Control knob
11 Passage
12, 14 Legs
15 End
16 Yarn guide element
17 Yarn spool
18 Axis of rotation
19 Pivot axis
21 Yarn
22 Stop peg
23 Yarn guide element
24 Yarn spool
25 Rotation transducer
26 Processing device
27 Yarn applicator element
28 Pin
29 Force sensor
31 Yarn tension sensor
32 Cutout
33 Actuating mechanism
34 Gear wheel
35 Rack

36, 37 Gear wheel
38 Lever
39 End
41 Protrusion
42 Opening
43 Sliding-block guide
44 Wall
45 Tension spring
46 Battery compartment
47, 48 Batteries
49 Switch
E Plane